Advice & Counsel

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Cyanide Safety – Part II: Emergency Response

We hereby continue our discussion from last month about cyanide safety. Here is the original question:

Dear Advice & Counsel,

My company has recently installed a metal stripping process that utilizes cyanide containing proprietary product. I am not familiar with how to use cyanide safely and would like some basic cyanide safety information. Can you help?

Signed,
Casey Enn

First a correction: last month we indicated that a Cyanide First Aid/Antidote kit was manufactured by Eli Lilly. This information was outdated, as the kit is now manufactured by Taylor Pharmaceuticals in Decatur IL.

Before using or working with any chemical product containing cyanide, it is important that the Material Safety Data Sheet be consulted for details on product hazards, recommended handling precautions and product storage. A wealth of useful information can be gleaned from the MSDS.

Cyanide and heat

Solid sodium cyanide decomposes very rapidly when heated above about 140°F (60°C) (See Fig. 1 from DuPont). The decomposition products include cyanide gas, ammonia and oxides of nitrogen. Storage in rooms that are conditioned to remain below a safe 120°F (49°C) or lower should be utilized. Do not store in a room where the temperature may exceed the critical temperature at any time.

Once the cyanide is mixed with water, the solution may be heated above 140°F (60°C), but the higher it is heated the more it tends to decompose, usually producing ammonia and carbonates.

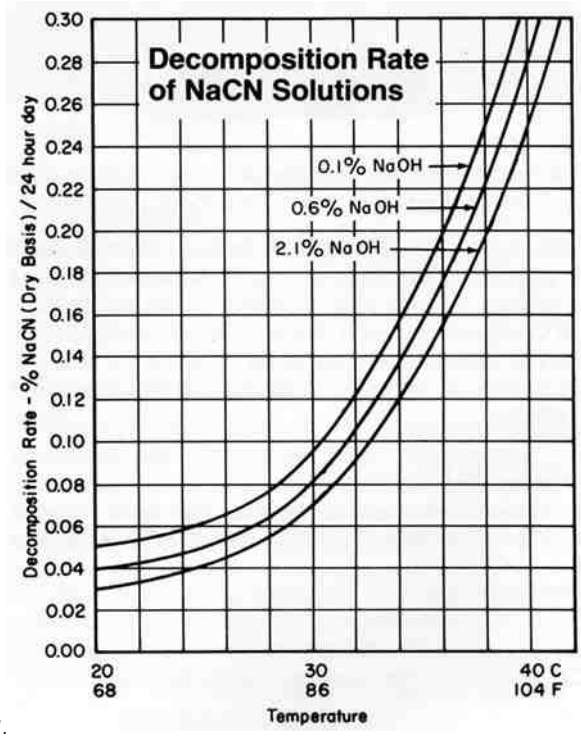

Figure 1.

When using electric immersion heaters to heat a process containing cyanide, failure to maintain proper volume level can expose the tank and the solution to excessive heat resulting in decomposition of the cyanide and a possible combustion hazard, particularly when plastic tanks are used. For this reason, it is not a good idea to use electric heaters on cyanide-bearing process tanks, even with over-temperature sensors.

Is Cyanide Explosive?

Cyanide is not considered an explosion hazard, but like many chemicals, if mixed with the "wrong" stuff, an explosion can result. First, a sealed container of cyanide can "explode" if heated to the decomposition temperature. This is very important for fire fighters. In a fire, containers of cyanide need to be cooled. This is more complicated than it sounds. Water can be used to cool the containers but water should not be used to fight fires if cyanide containers are ruptured (use foam instead). Foam has no cooling capacity, so it should not be used to try to cool closed containers. Cyanide is also incompatible with carbon dioxide extinguishers, because carbon dioxide and moisture produce carbonic acid which can produce cyanide gas.

In a fire, cyanide can explode if mixed with oxidizers such as chlorates or nitrites, so these need to be stored as far apart as possible. Other incompatibles with cyanide include all acids, nitrates, fluorine, magnesium and all oxidizers.

Cyanide and moisture

You will notice that cyanide is typically delivered in a drum with a steel ring that keeps a tight seal on the product (Fig. 2). That is because sodium and potassium cyanide are hygroscopic. That means they draw moisture from the air, if the container is left open. Workers must be trained to replace the metal ring and tighten it with a wrench. Do not just put the metal lid on the container.

Figure 2.

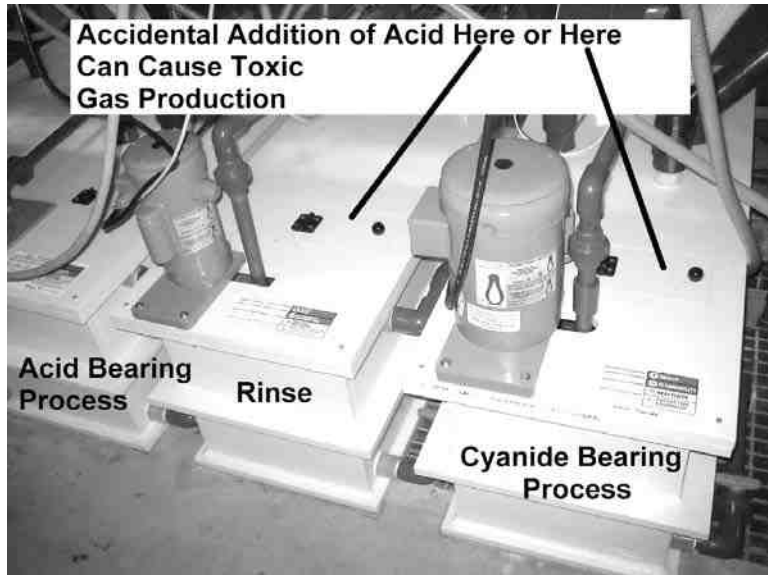

Figure 3.

Cyanide reacts with moisture to produce cyanide gas, ammonia and formate. It should not be stored underneath a sprinkler system. The storage area should be equipped with ventilation and a cyanide gas detector, if possible.

Cyanide and empty containers

Empty containers of cyanide must be triple rinsed before the container is considered to be truly empty by the USEPA.

Cyanide and acid-bearing processes

It is not unusual that a cyanide-containing metal finishing process has an acid-containing process nearby (Fig. 3). This poses several safety issues that need to be addressed:

- OSHA requires that cyanide and an acid that may mix with cyanide be diked off to prevent an accidental simultaneous spill from both tanks from combining to produce toxic gas. This is often a curb or collection tray located underneath one of the tanks (and the rinse tanks as well). Such trays do not prevent a pinhole leak in the side of the tank from "spraying" outside the containment. In some such cases, double wall tanks have been employed.

- Management needs to consider the possibility of a worker accidentally making an acid or cyanide addition to the wrong tank. Color coding, locked lids or additions made by two people (one adds while the second confirms the correct tank) are some of the management practices that have been utilized in some facilities.

- The rinses after acid must not be allowed to mix with the rinses after the cyanide process. Designated, color coded plumbing should be employed, and the rinses after cyanide need to be properly routed to a wastewater treatment system designed to destroy cyanide residuals.

Cyanide and worker health issues

Last month we discussed the high toxicity of cyanide and mentioned the primary routes of entry and health effects of cyanide exposure. This month we expand on the subject some more by suggesting that workers be given a medical exam prior to their employment near and with cyanide.

Figure 4.

Workers with pre-existing conditions such as central nerve damage, thyroid conditions or skin, heart or lung diseases should not be employed where cyanide exposure is a possibility.

We also mentioned that as little as 0.64 grams of sodium cyanide can cause death by ingestion in a 220-pound person. Figure 4 emphasizes just how little this amount is. ***P&SF***